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test and to strengthen those factors which are successful. This enables us to develop tests in the line of success as indicated by practice and not within the line which might be assumed by theory. If this method should claim the prerogative of "scientific," it would base the claim not upon the fact that it utilizes the findings of the medical examiner, nor upon the fact that it utilizes the findings of experimental psychologists, but upon the fact that it reduces the entire process to measurable terms which may be checked up by known and recognized standards.

THE USE OF MENTAL TESTS IN VOCATIONAL GUIDANCE[1]

BY GUY MONTROSE WHIPPLE,

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Mr. Chairman, Ladies and Gentlemen:

When Mr. Davis, just a few days ago, asked me to take the place of Dr. Bassett, who has been unfortunately prevented by illness from filling the engagement assigned him on your program, I consented with the understanding that the presiding officer in introducing me would apologize for the unavoidably hasty preparation and somewhat too sketchy character of my offering. I am unable to present to you anything like a comprehensive survey of the application of mental tests to vocational guidance, but have limited myself to presenting a few of the general principles that seem to me operative in that application and to illustrating, by reference to results recently obtained from a single mental test, something of the service that tests may render in the direction of diagnosing degree of general native ability.

I suppose there is little doubt that the majority of occupations are chosen by chance, which is equivalent to saying that they are not chosen at all. A considerable fraction, I suppose probably a majority, of those gainfully employed might, under very slightly changed conditions, have been in some other vocation than the one

[1] This paper was read by the author before the National Vocational Guidance Association at Detroit, February 22, 1916.

they are following. Nevertheless, there is little doubt that certain *types* of occupations or certain *levels* of occupation are pretty definitely selected or foreordained for every worker. Once I had passed my pre-adolescent conviction that to be a locomotive engineer was the acme of bliss, I never entertained any doubt but that I should devote my life to some profession. I think I might have succeeded as a lawyer or a physician. I think that an expert in vocational guidance might have discovered by a few tests even in my early high-school career that I had a bent toward intellectual pursuits. I think he might also have discovered that I had a fondness for music, but not aptitude in the execution of music sufficient to justify a career as a musician. I think he might also have discovered that, while able to do creditable work in high-school and college mathematics, I did not show any special mathematical talent. I think he might have discovered that I succeeded quite well in tests that put a premium upon the use of language and that he might have augured that I could succeed as a teacher of languages (which was, as a matter of fact, one of my early college ambitions). I doubt very much, however, whether he could have discovered by any system of mental tests that I should ultimately devote my attention to psychology and its applications to educational problems.

These rather personal reflections I introduce to indicate my conviction: (1) that there is a tendency, even though not a clearly conscious tendency, for individuals to gravitate toward that type of occupation that is generally suited to their ability and inclinations; (2) that certain occupational levels are delimited by fairly definite boundaries over which some individuals may pass readily and others not at all; (3) that the application of mental tests may be expected to determine some of these boundaries and some of these individuals, but (4) that we cannot expect mental tests to yield any simple set of measuring rods by which school children may be sorted out precisely, mechanically and complacently into various occupational groups.

The psychologist, in my judgment, would better wear a veil of modesty and not seek to emulate the boastings of physiognomic charlatans who claim to have selected 12,000 persons for 12,000 jobs without one single mistake by their system of concave and convex faces!

It is in a modest spirit, then, that I shall consider a few of the aspects of the question: what can be hoped for from the psychologist in vocational guidance? More specifically, is there any chance that mental tests may be used to select persons for a position or to select positions for a person? The latter problem is confessedly far more difficult than the former. Though we admit that the selecting of a proper position for a person is very difficult, we may yet indirectly accomplish something toward it in a negative way. That is, it is possible that in attempting to select the right persons for a position, we may at least discover what different callings a given individual ought *not* to enter.

Now, the development of mental tests has been in two fairly distinct directions. In the first place, there have been developed systems or combinations of tests (of which the Binet-Simon tests are easily the best-known example) for estimating somewhat roughly the *general level of mental ability* of an individual: it is in this sense that we speak of a child as two years mentally retarded or of an adult as being average, inferior, in the top 5 per cent, etc. The Binet tests do not permit reliable diagnosis above the age of ten or eleven years; on this account they are of little use to the vocational expert, save that they would enable him to cull out at any stage during the elementary school period pupils of distinctly inferior mental ability, or, for that matter, to detect pupils of distinctly superior mental ability. The perfection of a system of mental tests diagnostic of general intelligence in the adolescent and adult years is a problem that is interesting several investigators. We are making some attacks upon it at the University of Illinois, and I shall presently set forth a few of the results as tokens of progress in this direction.

In the second place, there have been developed numerous mental tests aimed at the measurement in a more exact manner of *specific mental abilities*. Some of these tests may obviously be useful in the selection of individuals for certain occupations. A simple illustration is afforded in the use of tests of color-blindness to keep color-blind individuals from entering the naval or marine service, in the use of tests of auditory acuity to select applicants for work in telephone exchanges or in the use of tests of tonal discrimination as proposed by Seashore for preventing unmusical children from wasting undue time in the study of music. The principle involved here

is simple enough, but its extension in practice presents many difficulties. It is evident, I mean, that to lay out all the boundaries or barriers that surround a given calling implies a very precise and exhaustive analysis of the abilities that are demanded by that calling. So far as I am aware, no psychologist has as yet presented us with such a complete and comprehensive analysis of the mental aptitudes that are essential for any single occupation.

In principle, once more, such an analysis appears relatively easy. It seems as if almost anyone could lay down the demands of stenography and typewriting—a fair degree of retentive memory, a good "ear," a reasonable amount of motor skill and dexterity, a reasonable readiness in learning new associative connections, especially between the sounds of certain verbal elements and the execution of correlated movements of the pencil. It seems as if almost anyone possessed of a working knowledge of experimental psychology and mental testing could then lay out a series of specific tests for these several capacities, determine standards of performance in them, and check them up by examining groups of successful and groups of unsuccessful stenographers and typists. I think myself that this program could be carried out, yet the fact remains that no one has accomplished it—perhaps because commercial schools will not pay the expert.

Moreover, most of the attempts in this general direction (the hypothetical analysis of a calling and the construction of laboratory tests that are presumed to measure the needed abilities)—most of the attempts in this direction have been so academic and theoretical in character as to make little impression upon the hard-headed man of business, or even upon the expert's colleagues. A case in point is the proposal of Münsterberg to measure fitness for the work of the sea-captain by the dealing of cards in his "Situation Test" and the thinly veiled irony of Breese, of Cincinnati, who, according to a recent article, discovered by this test that one of his students who displayed unusual quickness of decision in a real emergency got a very low rank in the test, whereas the person most fitted for sea-captaincy of all those tested by him turned out to be a "co-ed!" The moral is self-evident. Academic and arm-chair theorizing and testing must be checked by the "acid test" of experience. Wef must find out by actual observation of the success or failure of

every individual tested which ones of our mental tests do really do the diagnosing for us.

I find objections, likewise, to the notion that all that it is necessary to do is to test the individual by the use of actual *samples* of the occupations for which he is being considered. Naturally, the person who wanted a new bookkeeper and who went to a commercial school to get one, might very well give him a problem in bookkeeping to test his abilities. But the real issue, as I understand it, is: how can we discover before the student ever starts on a commercial course that he has a reasonable chance for success in that calling? We want to *predict* as well as to select.

As a matter of fact, the most hopeful type of work in the field of mental testing for vocational guidance is, as Dr. Hollingworth has pointed out in a recent article,[2] the administering of *miscellaneous* tests of a sort that promise well and the subsequent selection of the best of these tests by the purely pragmatic standard of "delivering the goods." In other words, we test a considerable number of persons by a number of tests; we then keep tab on their careers and eventually discover which of our tests were really most useful in diagnosis, which tests correlated best with the actual performance of our examinees. You are doubtless all familiar with the elaborate scheme of this sort now under way at Cincinnati. Work of this sort is bound to be tedious, but it promises well for the future.

So much for the general principles that seem to me operative in the use of mental tests for vocational guidance. I propose in the remainder of the time allotted to me to present some results recently obtained by the use of a mental test merely as a sample of the rather striking correspondence that obtains between the outcome of certain mental tests and actual achievement in certain forms of mental effort.

We decided at the University of Illinois to apply a number of mental tests to 200 or more students in the Urbana High School with the idea of comparing results in the tests with results in different types of school work and with the general intelligence of the students as estimated by their teachers. It would be impossible here to describe these tests in detail. Suffice to say that we sought in our selection of them to probe the mentality of the students from a number of different angles, and that any final determination of

[2] *School and Society*, June 26, 1915.

their intelligence would imply the pooling of the results of several tests. I speak today of preliminary results obtained from a single one only of these tests.

This test is known as the Analogies Test, or the Mixed Relations Test, and is described fully in my text-book.[3] The materials for this test consist of a series of twenty small cards, on each of which are printed three words. The first and second words stand in some sort of relation to one another; as soon as possible on seeing the card the student must name a fourth word which stands in a similar relation to the third word given on the card. The four words constitute a sort of verbal proportion. Thus, *King: Kingdom = Emperor: ?* Again, *Balloon: Air = Cork: ?* Again, *Winter: Summer = North Pole: ?* The experiment is conducted individually. As each card is shown, the experimenter starts a stop-watch; he stops the watch and reads the time when the subject utters the needed fourth term. If the student is unable to name the correct fourth term within 30 seconds, the time is recorded as 30 seconds and the next card is shown. The student's record is finally calculated as the average (or the median) of twenty trials with twenty different cards.

We shall eventually test about 200 students. The results already obtained show that school grade and age play a certain part in the outcome. As to relation with age, consider for a moment the following averages for sophomores 14, 15, 16, 17 and 18 years of age, respectively; they run 11.6 sec., 12.5 sec., 13.7 sec., 14.7 sec., 15.3 sec.—clear evidence that the younger the sophomore, the quicker, on the average, is he to detect the logical relations of the analogies test. The interpretation of these figures is that, on the average, the younger the pupil in a given high school class, the more intelligent he is.[4]

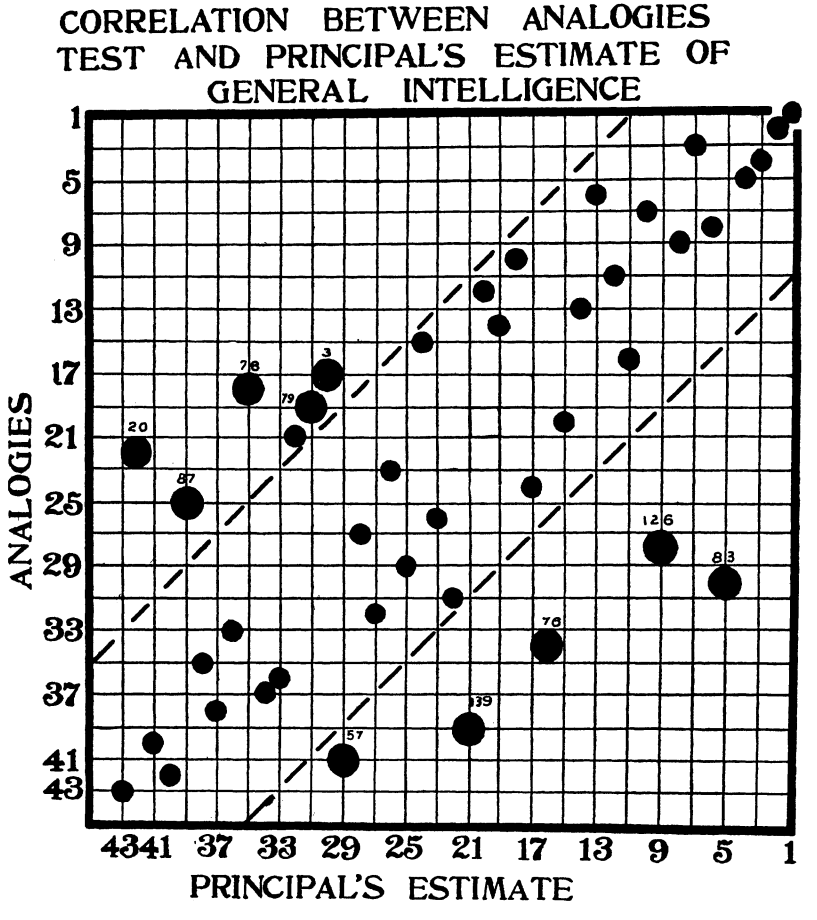
But these differences between groups arranged by classes or by

[3] See *Manual of Mental and Physical Tests*, 2d edition, Baltimore, Md. (especially under Test 34A in Part II).

[4] Those who believe that the tendency of older pupils to drop out of the high school is due to a failure on the part of the school to provide work suitable to their greater maturity need to consider whether they are not reversing the statement. It is much more likely that the older pupils drop out of the high school because they are intellectually incompetent to do the sort of work that is normal and proper to the high school.

ages are insignificant when compared with the differences of native ability revealed among individual students.

A few figures will bring this out. Correlation by the method of rank-order between performance in this test and the general intelli-



gence of forty-three high school freshmen as estimated by their English teacher was $r = +0.61$. The same correlation based on general intelligence as estimated by the high school principal was $r = +0.74$. This particular correlation is shown graphically in

figure 1. Here, each circle represents a high school freshman: his circle is located a distance *up* corresponding to his standing in the *analogies* test and a distance to the *right* corresponding to his *intelligence* as estimated by his principal. Number 1, best in our test, is Number 1 in the principal's opinion: Number 2 in our test is Number 2 in the principal's opinion: Number 3 in our test is Number 7 in the principal's opinion: Number 43 in our test is Number 43 in the principal's opinion. All the circles lying between the two parallel dotted lines evidently group along a line running from northeast to southwest, with such occasional fluctuations as might be anticipated (fluctuations quite as likely to be due to mistaken judgment of the principal as to failure of our test to measure ability accurately).

But outside the parallel lines are several circles that may well disturb the experimenter. These are cases in which the outcome of the test fails more or less conspicuously to accord with the principal's estimate and they may dispose you to be sceptical of a psychologist's claims to measure ability. But not too fast! Let us scrutinize a few of these exceptions.

Case 83[5] is a girl rated 5 in 43 by the principal and 30 in 43 by the analogies test. Her school grades are found to lie in the 90's with an average for the year of 93. Here our test certainly seems to have "missed fire." On asking the girl why she did so poorly in our test we discover (what she had said nothing of before) that on the day when she was tested she had just returned to school after a two weeks' illness. We do not guarantee our test to work under such conditions.

Case 126 is rated 9 in 43 by the principal and 28 in 43 by the test. But we find that his average school grade is but 83, with a range of 79 to 87, where the pass mark is 75 and exemption is at 90. There is a strong probability that his intelligence is overrated by the principal. The boy is honest, robust, congenial, wholesome and much liked by the principal as a fine fellow in the school—sufficient explanation for the overrating of native intellectual ability.

[5] On the chart displayed at Detroit these 'exceptions' were indicated by red bands surrounding the circles (see the larger circles in figure 1). The numbering was merely used for convenience in referring to the list of students under investigation. The reader can locate the cases by reference on figure 1 to the rating given in each case by the analogies test and by the principal's estimate.

Case 139 is a girl ranked 21 in 43 by the principal and 39 in 43 by our test. The school records show that she never got a mark above 83, that her average mark is only 78 and that she barely passed in algebra and physiography. The fact that she has talent in drawing and painting and that some of her work has been on exhibition in the superintendent's office may very well account for the principal's overestimation of her general intelligence.

Case 78 brings out a touch of humor. This girl was ranked by us 18 in 43, but by the principal relegated to thirty-fifth place. On telephoning the principal to discover why he made such a decision we discovered (unfortunately, after this chart was made) that the principal "had the wrong pig by the ear." He was ranking another girl of the same name, and he agreed that our ranking of the girl we had tested was entirely right.

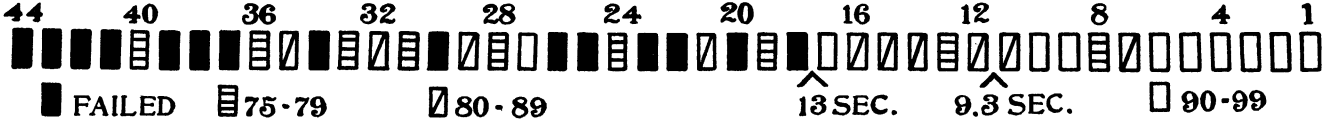
Case 20 is ranked by our test as average (22 in 43) but given by the principal a rank of very poor (42 in 43). Here we are inclined to agree with the principal's ranking, if intelligence is indicated by school performance. This boy is notoriously lazy, irrepressible, a shirker, an only child and a spoiled one. The experimenter's subjective estimate of his ability was recorded as "average," which agrees exactly with the outcome of our test.

Our data suggest very clearly these conclusions: when ability is strikingly superior, school performance is superior, whether the student is industrious or not. When ability is strikingly inferior, school performance is quite inferior whether the student is industrious or not. When ability is of average amount, school performance is distinctly affected by industry and zeal. Most of the divergences between the test results and the school's records or the teacher's estimates pertain to the position of these students of average native ability.

Finally, I wish to speak briefly of the peculiar relation between the analogies test and algebra. Early in our work we found that students who did very poorly in the analogies test quite frequently reported algebra as the high school subject which was most difficult for them, whereas students who did excellently in the analogies test almost invariably preferred algebra to other studies and secured high grades in it. I shall not stop to discuss why this relation ob-

RELATION BETWEEN ANALOGIES TEST AND ALGEBRA GRADES

44 HIGH-SCHOOL FRESHMEN.



tains, save to hazard the guess that algebra puts a high premium upon ability to perceive and handle logical relations and that this ability is also demanded in the analogies test. I shall demonstrate the nature of the relation by a few figures and a graphic representation. The correlation between the mathematical ability of 30 freshmen, as estimated by the teacher of algebra in the Urbana High School, and the ranking of these freshmen in the analogies test reaches the extraordinary amount of $r = +0.78$. The correlation between the actual grades in algebra of 43 freshmen and their standing in the analogies test reaches the equally surprising amount $r = 0+71$ (P. E. about .07). This last relation is shown in figure 2, to which your attention is now called. Here each rectangle represents one high school freshman. The cases are arranged in order from right to left, according to their performance in the analogies test. Number 1, at the right, is best in our test; Number 43 at the left, is poorest in our test. Their grades in algebra are represented by different fillings of the rectangles. Solid rectangles mean "failed in algebra." Unfilled rectangles mean "secured a mark of 90 or above in algebra." Rectangles with horizontal cross-lines mean "poor in algebra" (grades between 75, passing, and 79). Rectangles with a diagonal cross-line mean "medium in algebra" (grades between 80 and 89). Notice the following features. The highest 6 students in our test get 90 or above in algebra. The poorest 4 students in our test all fail in algebra. Take a point of division represented in our test by a speed of 13 seconds. Below this score are 27 cases; 15 of them fail in algebra. Above this score are 17 cases; not one of them fails in algebra. Take another point represented by a speed of 9.3 seconds in the test. Above this mark are 11 cases of which 8 gain grades in algebra of 90 or above.

There are on this chart, naturally, a few instances in which the grade in algebra does not accord so neatly with performance in the test. I have an adequate explanation of them.[6]

[6] Case 53 is ranked 7 in our test but gets only 83 in algebra. She is a girl who is known in the school as a 'character.' She is carrying seven subjects and is reciting at every period of the day. Her morals are not of the best and she apparently spends most of her time outside of school in walking the streets. She is known as a sporty personage and shows indications of being a pathological liar. These conditions are sufficient to explain why, although seventh in ability, according to our test, she receives a mark of only 83 in algebra.

Case 85 ranks 8 in our test but barely passed in algebra. It is found that

What I have presented is but a portion of the results that have been secured from the application of a single mental test. I leave it to your judgment whether these results are not sufficiently significant to justify my original contention that there is a place in the public schools for work with other mental tests than the Binet-Simon system to which attention has been thus far restricted. Could any one ask for a better diagnostic of future success or failure in algebra than the results of this analogies test alone—a test that can be applied to any student within fifteen minutes? When other tests with which we are working and of which I have said nothing at all—tests that, for example, show interesting correlations with linguistic instead of mathematical ability—are included, it will be seen that it is no fanciful dream to declare that the psychologist is not far from a position in which he can render most valuable assistance to school authorities by the examination of *individual* students for the diagnosis of their mental equipment, their personal abilities and disabilities of mind.

he comes from a very poor home, is very dirty and slovenly in appearance, but has evident ability, because he won a prize for the construction of a kite in competition with a large number of boys. We find on further investigation that he missed a test in algebra that he failed to make up, which accounts for his grade of 75.